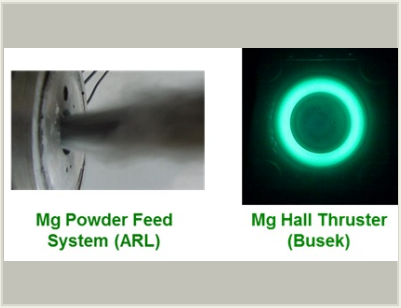
Magnesium Hall Thruster for Solar System Exploration, Phase II

Completed Technology Project (2012 - 2014)

Project Introduction

The innovation being developed in this program is a Mg Hall Effect Thruster system that would open the door for In-Situ Resource Utilization based solar system exploration. Magnesium is light and easy to ionize. Performance advantages of a Mg thruster include far higher specific impulse and less life limiting erosion. Additional advantages include low propellant cost and low pressure propellant storage. A system efficiency >50% is expected from an optimized, high power Mg HET. More importantly, the Isp for a high efficiency magnesium Hall thruster driven by a 400V power processing unit may exceed 5000s. For a Mars-Earth transfer, the propellant mass savings with respect to a xenon HET system are enormous. Mg can also be combusted in a rocket with CO2 or H2O, enabling a multi-mode propulsion system with propellant sharing and ISRU. In the near term, CO2 and H2O would be collected in-situ on Mars or the Moon. In the far term, Mg itself would be collected from Martian and lunar regolith. In Phase I, an integrated, medium power (1-3kW) Mg HET system was developed and tested. Controlled, steady operation at constant voltage and power was demonstrated. Preliminary measurements indicate Isp >4000 s was achieved at a discharge potential of 400V. The feasibility of delivering fluidized Mg powder to medium or high power thruster was also demonstrated. The objective of Phase II will be to evaluate the performance of an integrated, high power Mg Hall thruster system in a relevant space environment. In the first task, we will improve the medium power thruster system and characterize it in detail. In the second task, the knowledge gained will be used to design and build a high power (8-20kW) Mg HET. In the third task, a fluidized powder feed system supporting the high power thruster will be built and delivered to Busek. In the fourth task, the integrated high power system will be fully characterized. Measurements will include performance and plume properties.



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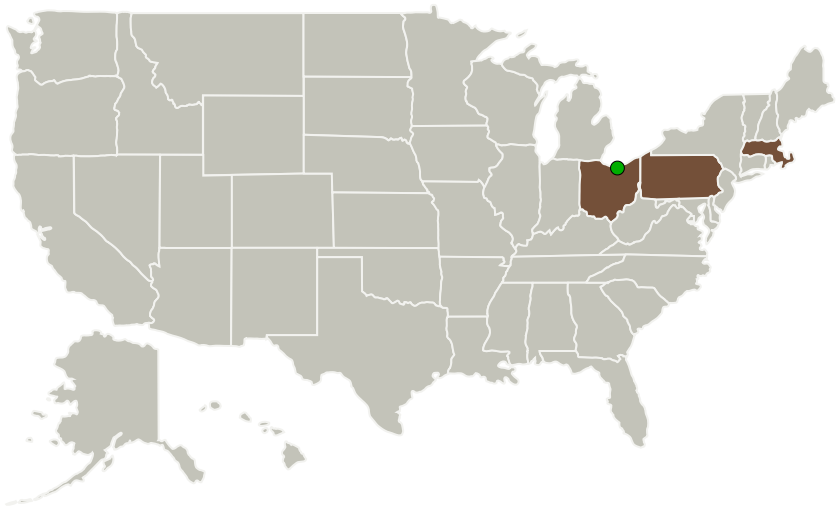
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Massachusetts	Ohio
Pennsylvania	

Project Transitions

June 2012: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Busek Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

James Szabo

Co-Investigator:

James Szabo

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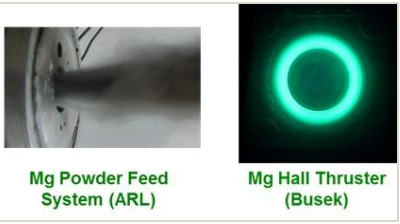
December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137301)*

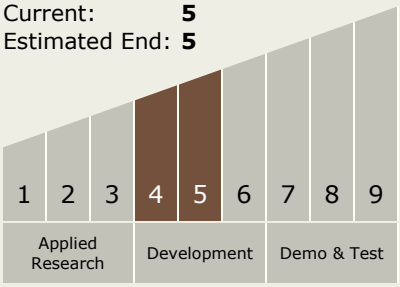
Images



Project Image
Magnesium Hall Thruster for Solar System Exploration
(https://techport.nasa.gov/image/129938)

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System